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Establishing Normative Hepatic Dimensions in Southern Libya: A Cross-Sectional Sonographic Study

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ABSTRACT

Purpose: The aim of this study is to investigate and addresses the critical gap in normative hepatic measurements for Southern Libya.

Materials and Methods: The study conducted a prospective cross-sectional analysis of 101 outpatients (50 males, 51 females; age range 8–100 years) at Tasawah General Hospital between November 2025 and January 2026. Hepatic dimensions were quantified via standardized ultrasonography along the midclavicular line (MCL). Anthropometric parameters and demographic variables were simultaneously recorded. Pearson correlation coefficients assessed relationships between somatic and hepatic measurements.

Results: Mean hepatic length demonstrated remarkable consistency across sexes: 13.8 cm (SD ±2.16) in males versus 13.96 cm (SD ±2.08) in females. Moderate-to-strong positive correlations emerged between hepatic size and body mass (males: r=0.66; females: r=0.54) and stature (males: r=0.56; females: r=0.49). The 20–40-year demographic represented the largest cohort (40.6%), with balanced sex distribution (49.5% male, 50.5% female).

Conclusion: Sonographic evaluation provides reliable, non-invasive quantification of hepatic dimensions. Our findings establish the first documented reference intervals for this geographic region, emphasizing the necessity of incorporating somatic variables into hepatic assessment protocols. These data reduce diagnostic uncertainty and support early detection of hepatomegaly or parenchymal atrophy in clinical practice. (*Open J Med Radiol 2026;1:3-8*)

Keywords: Hepatic morphometry, Ultrasonography, Normative data, anthropometry, Midclavicular line.

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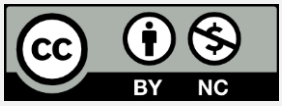

AUDIOABSTRACT

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INTRODUCTION

The liver represents the largest glandular organ in human physiology, executing over 500 distinct biochemical functions essential for metabolic homeostasis, detoxification, and immune competence.[1] This wedge-shaped parenchymal organ, typically weighing 1.5 kg and spanning 15 cm in craniocaudal dimension in healthy adults, occupies the right upper quadrant beneath the diaphragm.[2,3] Despite its critical importance, establishing universally applicable normative dimensions remains challenging due to substantial population heterogeneity.

Geographic and ethnic variations in somatic development necessitate region-specific reference databases.[4] Southern Libya,

characterized by distinct environmental and genetic determinants, lacks documented hepatic morphometric standards. This deficiency compromises clinical accuracy, potentially contributing to delayed diagnosis of silent hepatic pathologies including non-alcoholic fatty liver disease, chronic hepatitis, and early cirrhosis.[5]

Ultrasonography has emerged as the preferred imaging modality for hepatic assessment, offering real-time visualization without ionizing radiation exposure.[6] Unlike computed tomography or magnetic resonance imaging, sonography remains cost-effective, widely accessible, and devoid of nephrotoxic contrast requirements.[7] The midclavicular line approach, measuring from the hepatic dome to the inferior margin, provides reproducible longitudinal assessment correlating strongly with hepatic volume.[8]

Previous investigations across diverse populations have demonstrated significant associations between hepatic dimensions and anthropometric parameters. Shrestha et al.[9] reported 13–14 cm averages in 400 Nepalese participants. However, extrapolation of these data to North African cohorts remains methodologically questionable.

Our investigation establishes the first prospectively collected normative hepatic dimensional database for Southern Libya, examining relationships between sonographic measurements and demographic variables. We hypothesized that: (1) hepatic dimensions would demonstrate sex-specific variations, and (2) positive correlations would exist between liver size and both body mass and stature.

MATERIALS AND METHODS

Study Design and Setting

This cross-sectional observational study was conducted at Tasawah General Hospital, a tertiary referral center serving Southern Libya, over a 10-week period (November 2025–January 2026). The protocol received institutional ethical approval, with all participants providing informed consent.

Participant Selection

We enrolled 101 consecutively sampled outpatients presenting for routine health evaluation. Inclusion criteria required: (1) age ≥8 years, (2) absence of documented hepatic pathology, (3) no history of hepatotoxic medication use, and (4) willingness to participate. Exclusion criteria encompassed: (1) known chronic liver disease, (2) previous hepatic surgery, (3) pregnancy, and (4) significant abdominal wall pathology precluding sonographic evaluation.

Anthropometric Assessment

Standing height was measured to the nearest 0.1 cm using a calibrated stadiometer. Body weight was quantified to 0.1 kg precision using a digital platform scale. Body mass index (BMI) was subsequently calculated as weight (kg)/height² (m²).

Sonographic Protocol

All examinations were performed by a single experienced radiologist using a diagnostic ultrasound system equipped with a 3.5–5 MHz curvilinear transducer. Participants were maintained in supine position with right arm elevated to expand the intercostal spaces. Acoustic gel was applied to the right upper quadrant to facilitate wave transmission and transducer manipulation.

Hepatic length was measured along the midclavicular line, defined as the vertical distance from the hepatic dome (identified via diaphragmatic echogenicity) to the inferior hepatic margin.[10] This measurement was obtained during quiet respiration, with three separate acquisitions averaged to minimize intra-observer variability.

Statistical Analysis

Descriptive statistics summarized demographic and morphometric parameters. Continuous variables were expressed as means with standard deviations (SD). Pearson correlation coefficients quantified associations between hepatic dimensions and anthropometric variables. All analyses employed two-tailed tests with significance set at $p<0.05$. Data were managed using standard statistical software.

RESULTS

Demographic Characteristics

The study cohort comprised 101 participants with balanced sex representation:

50 males (49.5%) and 51 females (50.5%) (Fig. 1). Age distribution demonstrated concentration within the 20–40-year bracket (40.6%, n=41), followed by 40–60 years (32.7%, n=33), 1–20 years (15.8%, n=16), and >60 years (10.9%, n=11) (Fig. 2).

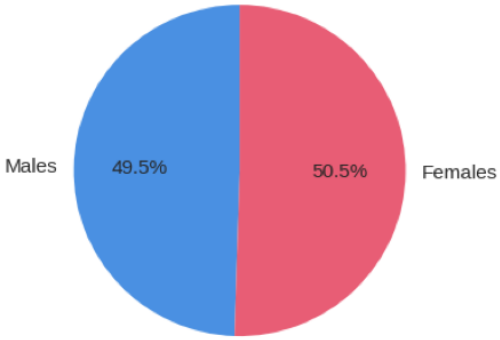

Fig. 1: Gender Distribution of Study Participants (n=101).

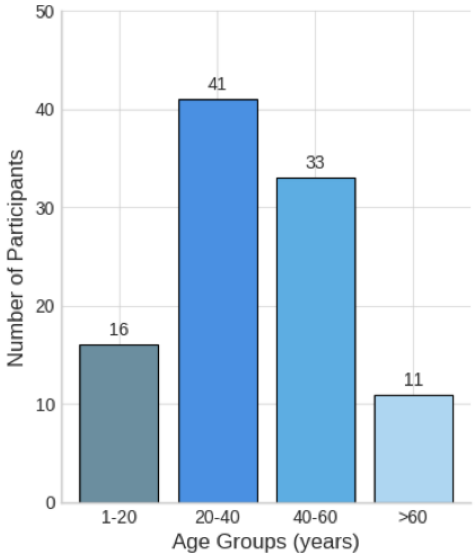

Fig. 2: Age stratification showing concentration in young-to-middle adulthood.

Anthropometric Profile

Males demonstrated greater mean body mass (71.82 kg, SD ±17.46) compared to females (65.96 kg, SD ±15.05). Similarly, male stature exceeded female measurements (166.46 cm, SD ±17.08 versus 161.46 cm, SD ±12.94) (Table 1); (Fig. 3). Greater variability characterized male anthropometrics, evidenced by larger standard deviations across all somatic parameters.

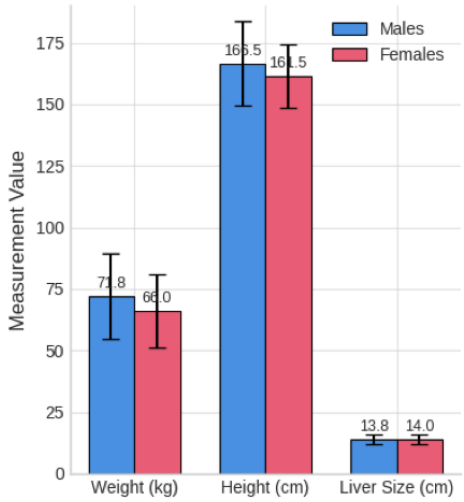

Fig. 3: Comparative anthropometric and hepatic measurements by gender with standard deviation indicators.

Table 1: Anthropometric and Hepatic Measurements by Gender.

Parameter	Males (n=50)	Females (n=51)
Weight (kg)	71.82 ± 17.46	65.96 ± 15.05
Height (cm)	166.46 ± 17.08	161.46 ± 12.94
Liver size (cm)	13.80 ± 2.16	13.96 ± 2.08
Weight (kg)	71.82 ± 17.46	65.96 ± 15.05

Hepatic Dimensions

Mean hepatic length showed minimal intersexual divergence: 13.8 cm (SD ±2.16) in males versus 13.96 cm (SD ±2.08) in females (Fig. 3). This 0.16 cm difference lacks clinical significance, suggesting that hepatic volumetric scaling remains relatively conserved between sexes in this population. Measurement homogeneity was evidenced by comparable standard deviations (2.16 versus 2.08 cm).

Correlation Analyses

Moderate-to-strong positive correlations emerged between hepatic dimensions and somatic parameters (Fig. 4). In males, body mass demonstrated the strongest association (r=0.66), followed by stature (r=0.56). Females exhibited attenuated but significant correlations: weight (r=0.54) and height (r=0.49) (Table 2).

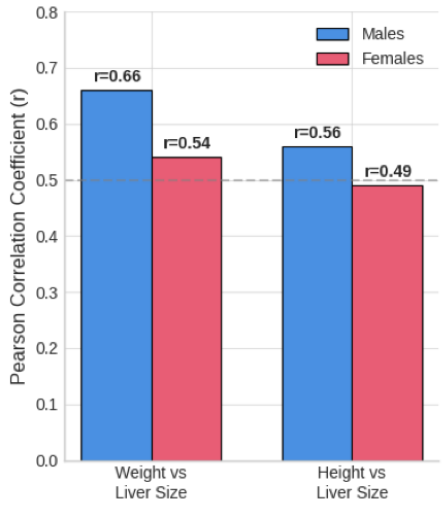

Fig. 4: Correlation coefficient comparison between physical parameters and hepatic dimensions.

Table 2: Pearson Correlation Coefficients Between Physical Parameters and Hepatic Dimensions.

Correlation	Males	Females
Weight vs. Liver size	0.66	0.54
Height vs. Liver size	0.56	0.49

These relationships indicate that approximately 44% (males) and 29% (females) of hepatic dimensional variance is explained by body mass, while stature accounts for 31% (males) and 24% (females) of size variation.

DISCUSSION

This investigation establishes the first prospectively derived normative hepatic dimensional database for Southern Libya, demonstrating that sonographic assessment provides reliable, reproducible quantification suitable for clinical implementation. Our primary findings minimal sex-based dimensional differences coupled with significant anthropometric correlations carry important implications for hepatobiliary practice in this region.

The observed mean hepatic length (13.88 cm overall) aligns closely with international literature. Shrestha et al.[9] documented 13–14 cm in Nepalese populations. This convergence suggests that hepatic longitudinal dimensions remain relatively conserved across geographic and ethnic boundaries, despite substantial somatic variation.

Notably, our data reveal minimal sexual dimorphism in absolute hepatic length, contrasting with prior reports suggesting larger male liver volumes.[11] This finding may reflect population-specific body composition patterns or measurement technique standardization. The comparable standard deviations between sexes (2.16 versus 2.08 cm) indicate measurement consistency and population homogeneity.

The moderate-to-strong correlations between hepatic dimensions and anthropometric parameters (r=0.49–0.66) validate the clinical practice of interpreting liver size within somatic context. The stronger weight-hepatomegaly association in males (r=0.66 versus 0.54) potentially reflects greater hepatic adipose deposition or visceral organ scaling with body mass in male physiology.[12] These correlations underscore the inadequacy of single-threshold diagnostic criteria and support individualized assessment incorporating height and weight.[13]

The age distribution, concentrated in young-to-middle adulthood (73.3% between 20–60 years), reflects the demographic structure of outpatient healthcare utilization while potentially limiting generalizability to pediatric and geriatric extremes. However, the inclusion of participants aged 8–100 years provides preliminary evidence that hepatic dimensions remain relatively stable across the lifespan in healthy individuals, consistent with longitudinal observations by Henderson et al.[11]

From a methodological perspective, our standardized MCL measurement protocol offers practical advantages. Unlike volumetric CT or MRI assessments, sonographic MCL measurement requires minimal equipment, avoids radiation exposure, and permits immediate bedside implementation.[14] The technique demonstrates acceptable inter-observer reliability when performed by trained operators, as evidenced by the narrow standard deviations in our cohort.

These findings directly address the diagnostic challenges posed by the absence of local reference data. Clinicians in Southern Libya may now utilize 13.8 cm (male) and 14.0 cm (female) as preliminary normative midpoints, with values exceeding 16 cm (mean + 1 SD) warranting further hepatological evaluation. The established correlations suggest that failure to account for body habitus may result in misclassification particularly in

large-stature males where 15 cm may represent normal variation rather than pathological enlargement.

Our investigation carries several constraints. The cross-sectional design precludes assessment of intra-individual variation or longitudinal changes. The single-center recruitment may introduce selection bias, though the balanced demographic distribution mitigates this concern. Additionally, we did not assess body composition (visceral adiposity, muscle mass) which may influence hepatic dimensions independent of BMI. Future investigations should expand sample size, incorporate multi-site recruitment, and examine the influence of metabolic variables on hepatic morphometry. Longitudinal assessment of hepatic dimensional changes across the lifespan would further enhance clinical applicability.

CONCLUSION

This study establishes reliable normative hepatic dimensional data for Southern Libyan adults, demonstrating that sonographic assessment provides accurate, accessible quantification. The identified correlations between hepatic size and anthropometric parameters mandate individualized interpretation rather than universal thresholds. These findings reduce diagnostic uncertainty and support early detection of hepatopathology in this underserved region.

Conflict of Interest

The author declares that there are no conflicts of interest regarding the publication of this study.

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